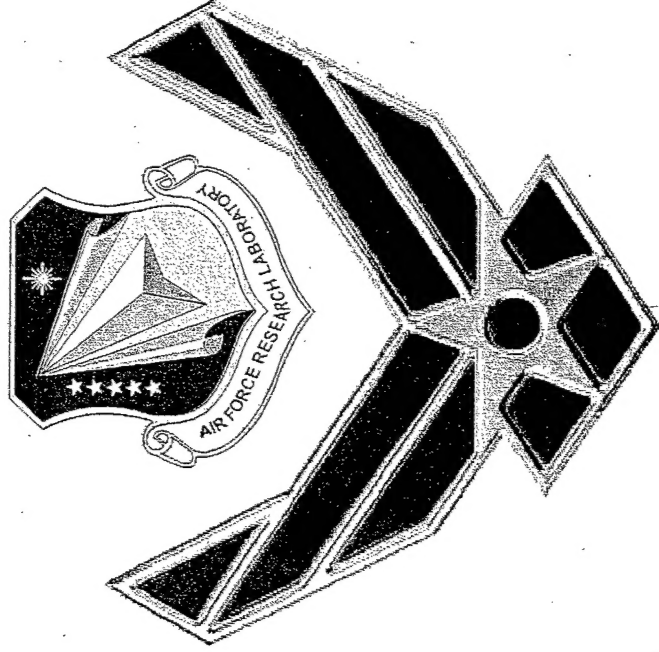


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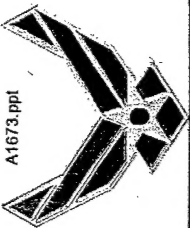
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Investigating Three- Dimensional Effect on Crack Growth Behavior in an Incompressible Material



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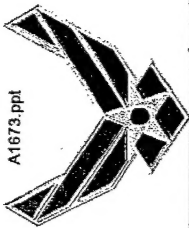
C. W. Smith
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Objective:

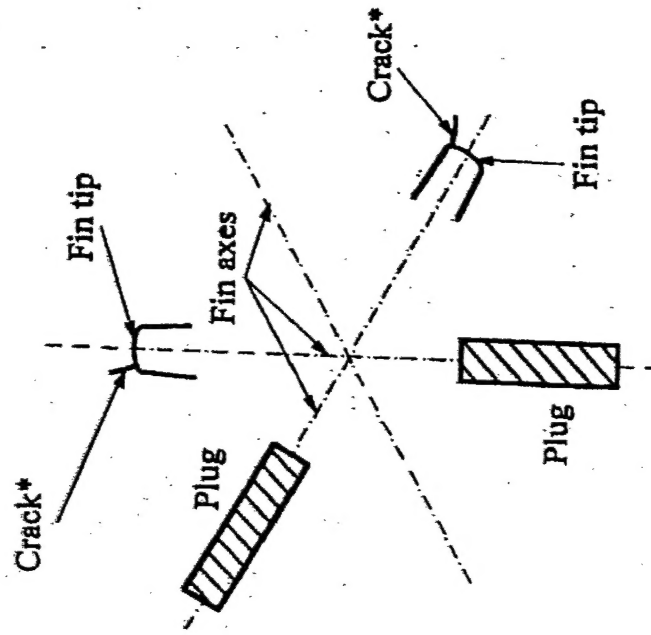
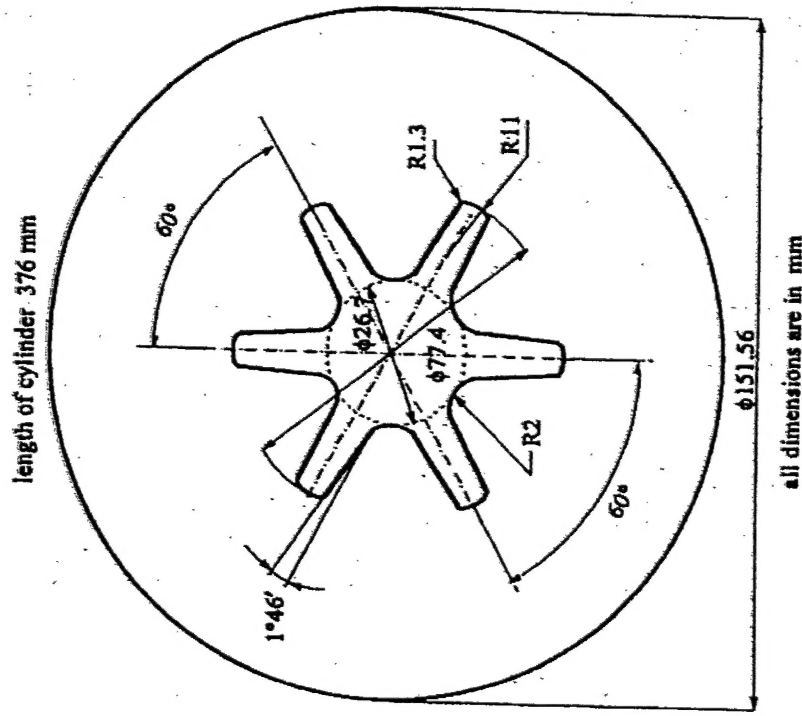
- Investigate the effect of crack location on the crack growth behavior in centrally perforated cylinders under internal pressure.



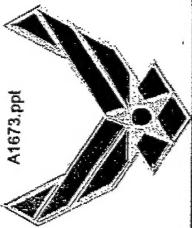


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Specimen Dimensions and Crack Locations

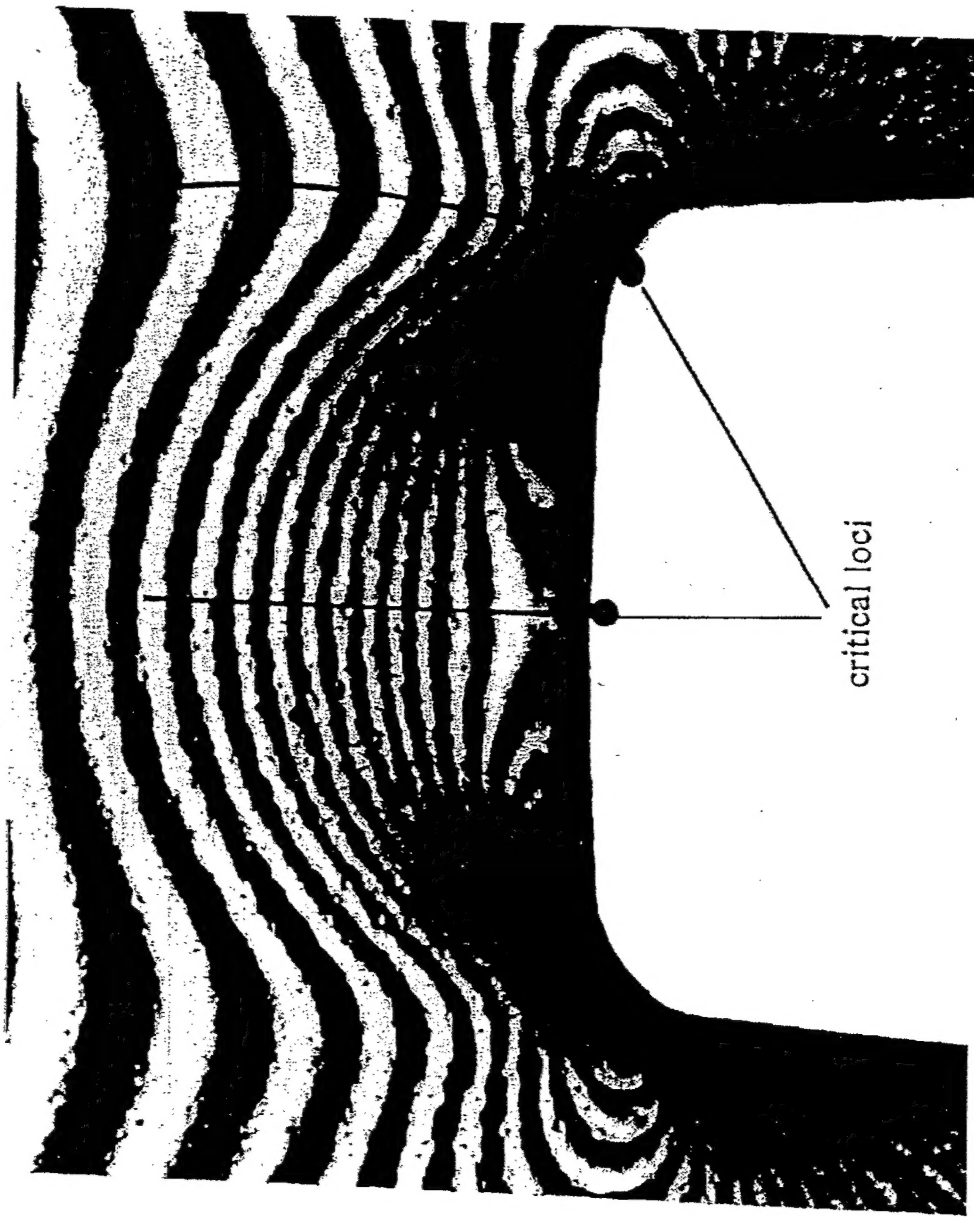


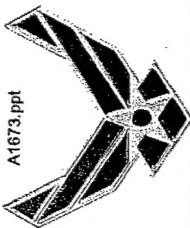
* Path of crack to maximum depth



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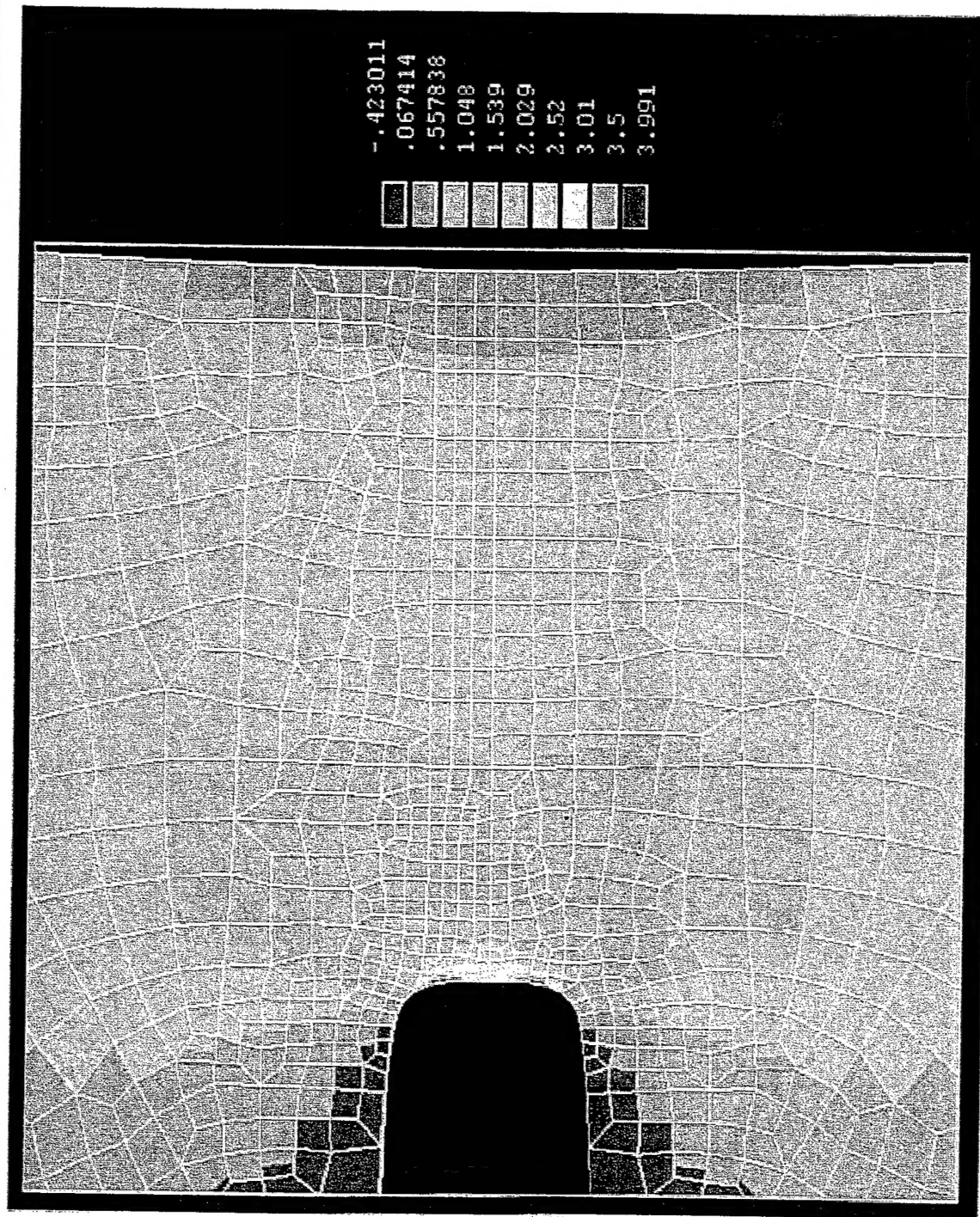
Fringe Patterns Near Critical Loci at Fin Tip

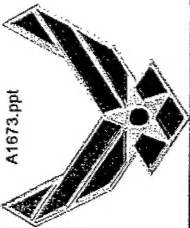




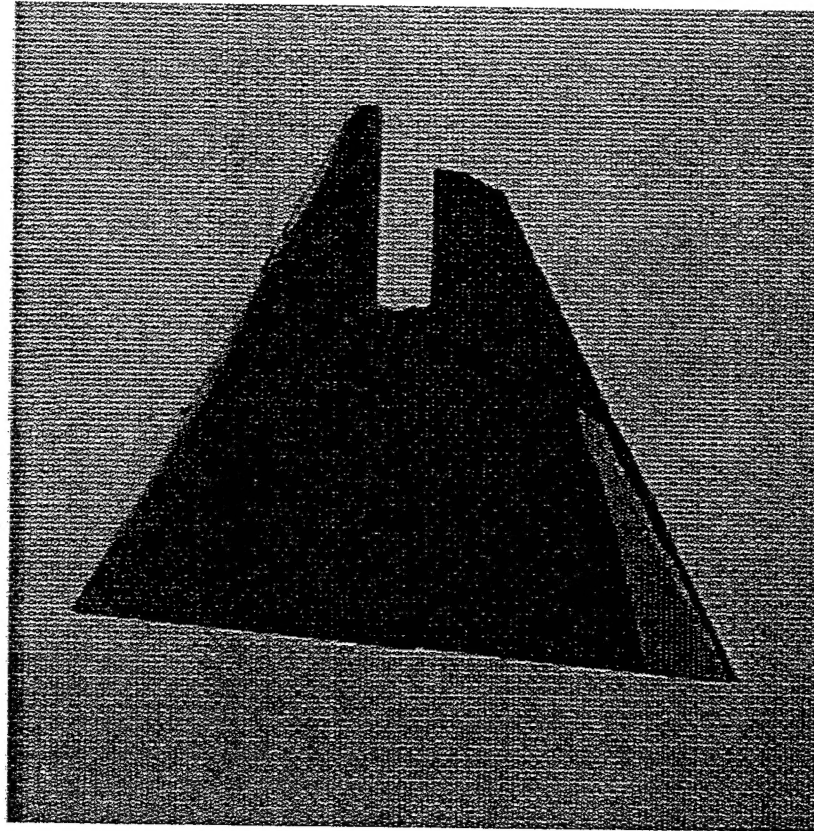
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Contour Plot of Stress σ_{yy} (No Crack)

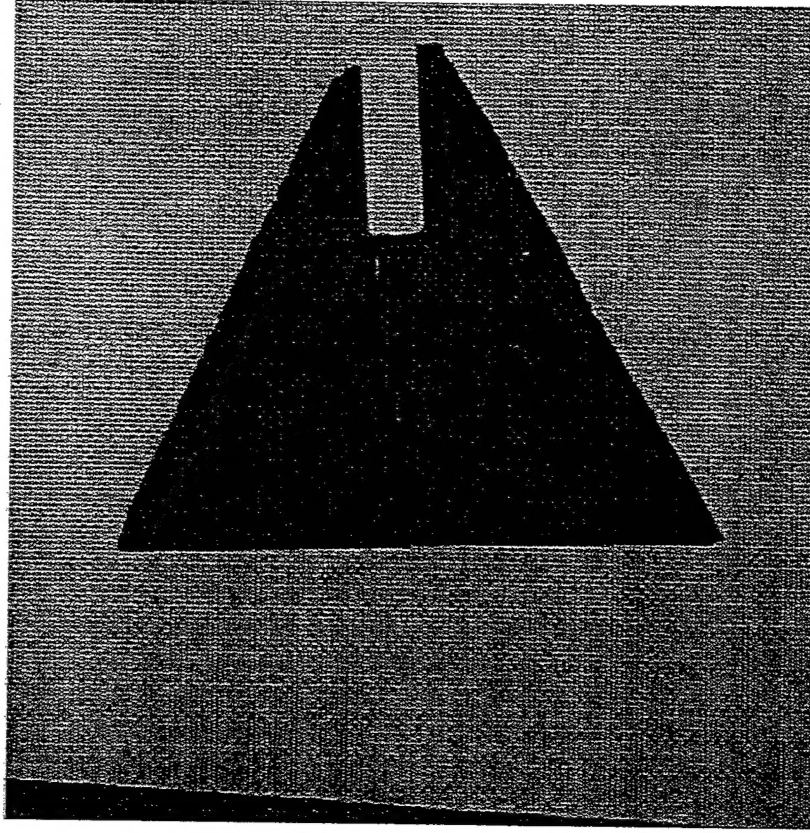




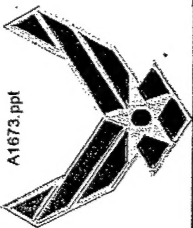
Two-Dimensional Crack Growth Tests



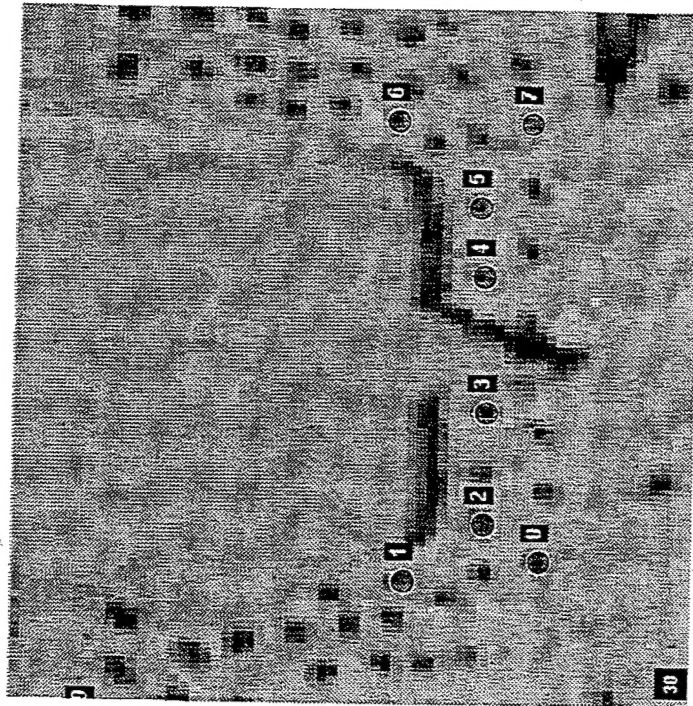
A



B

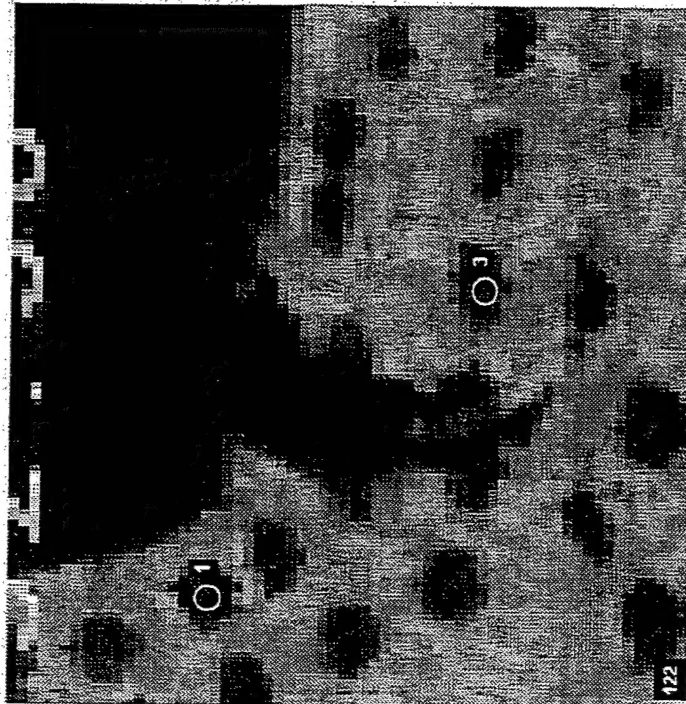


Two-Dimensional Crack Growth Tests



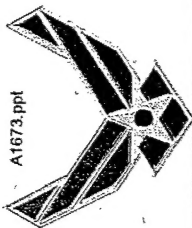
A

Crack initiated at the center of the fin



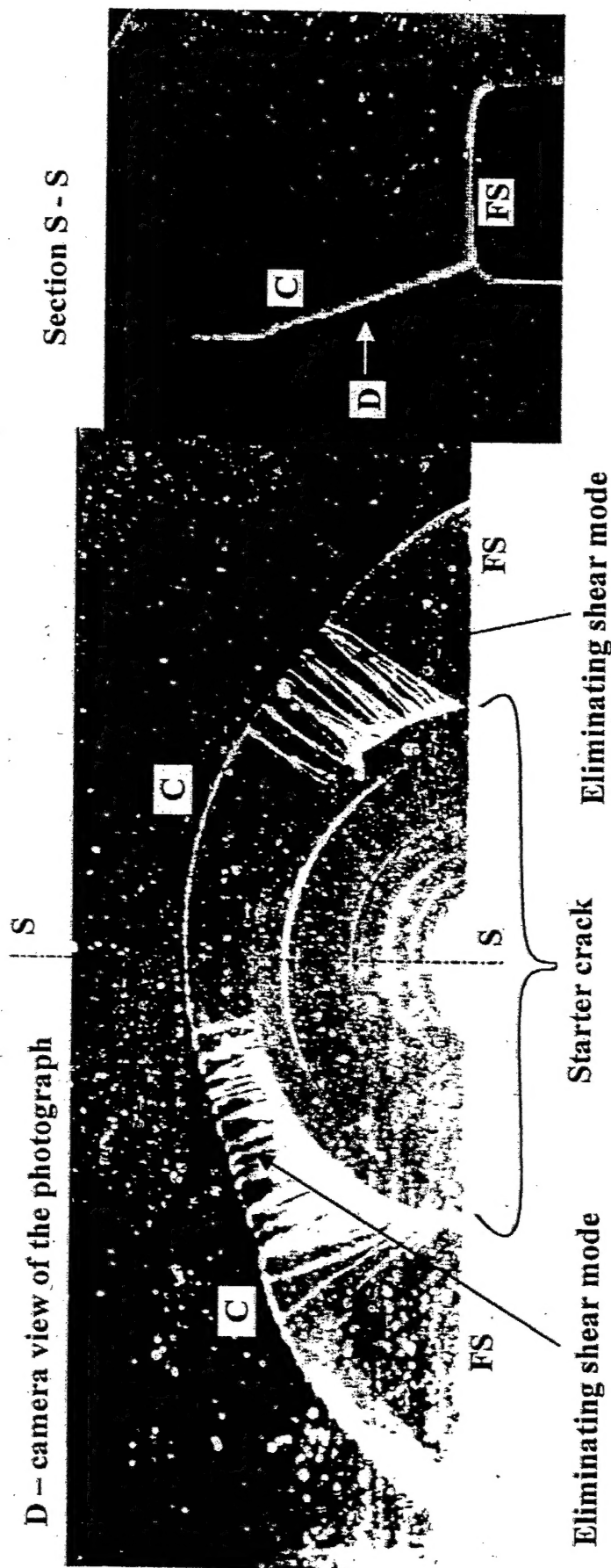
B

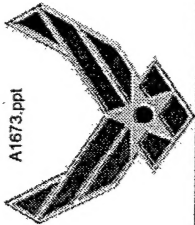
Crack initiated at the corner of the fin



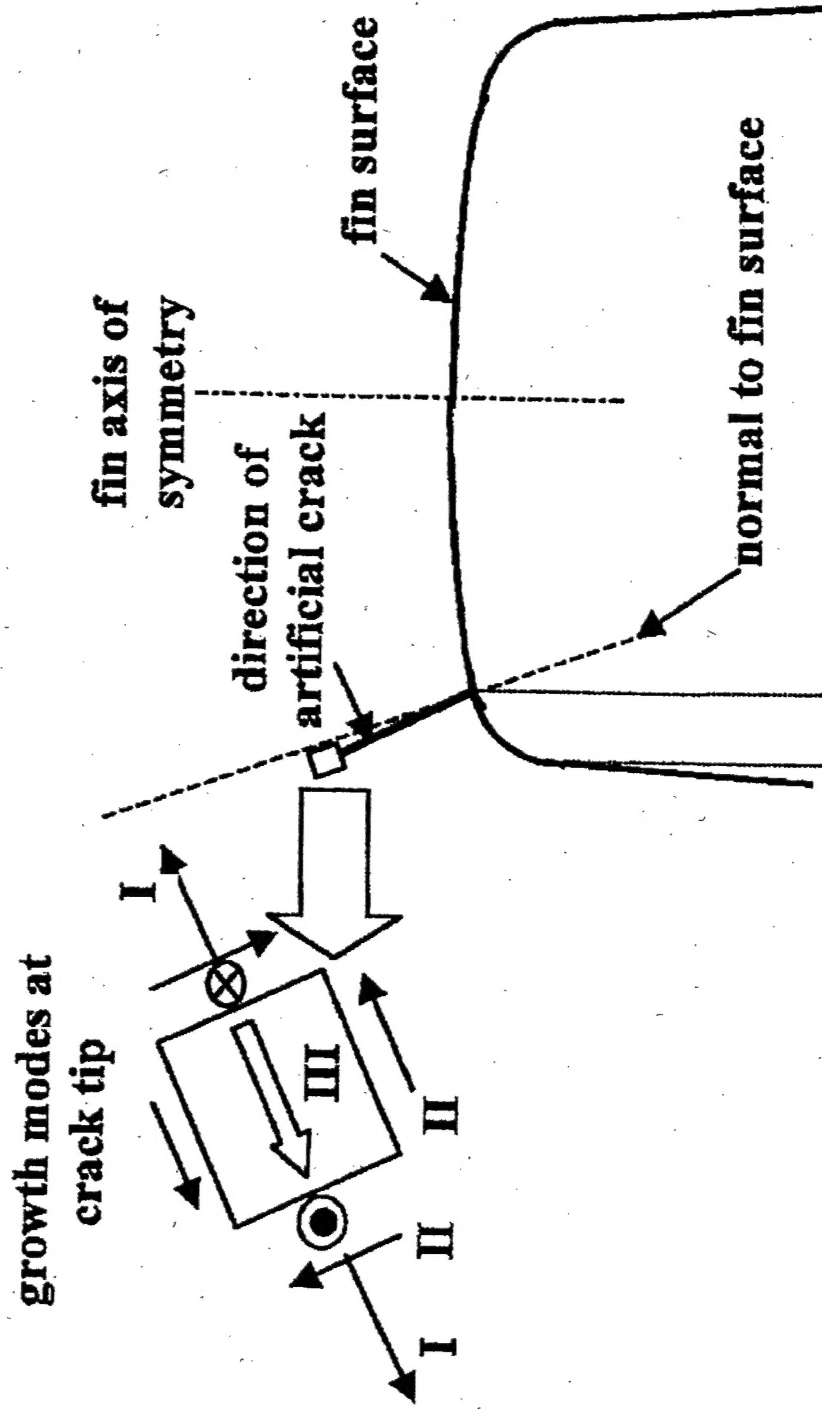
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Typical Off-Axis Inclined Crack Which is Perpendicular to the Fin Surface





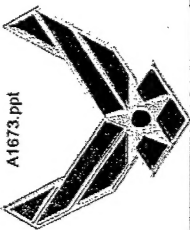
Stress Distribution at Crack Tip



I = Normal Stress (Mode I)

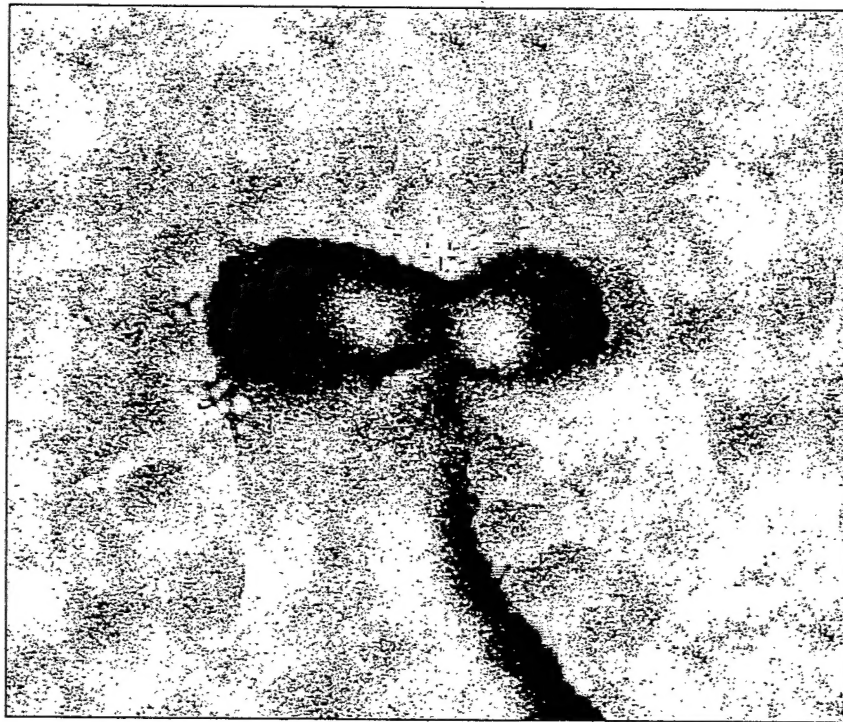
II = In-Plane Shear (Mode II)

III = Out-of-Plane Shear (Mode III)



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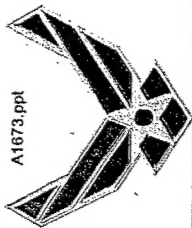
Photoelastic Fringe Patterns



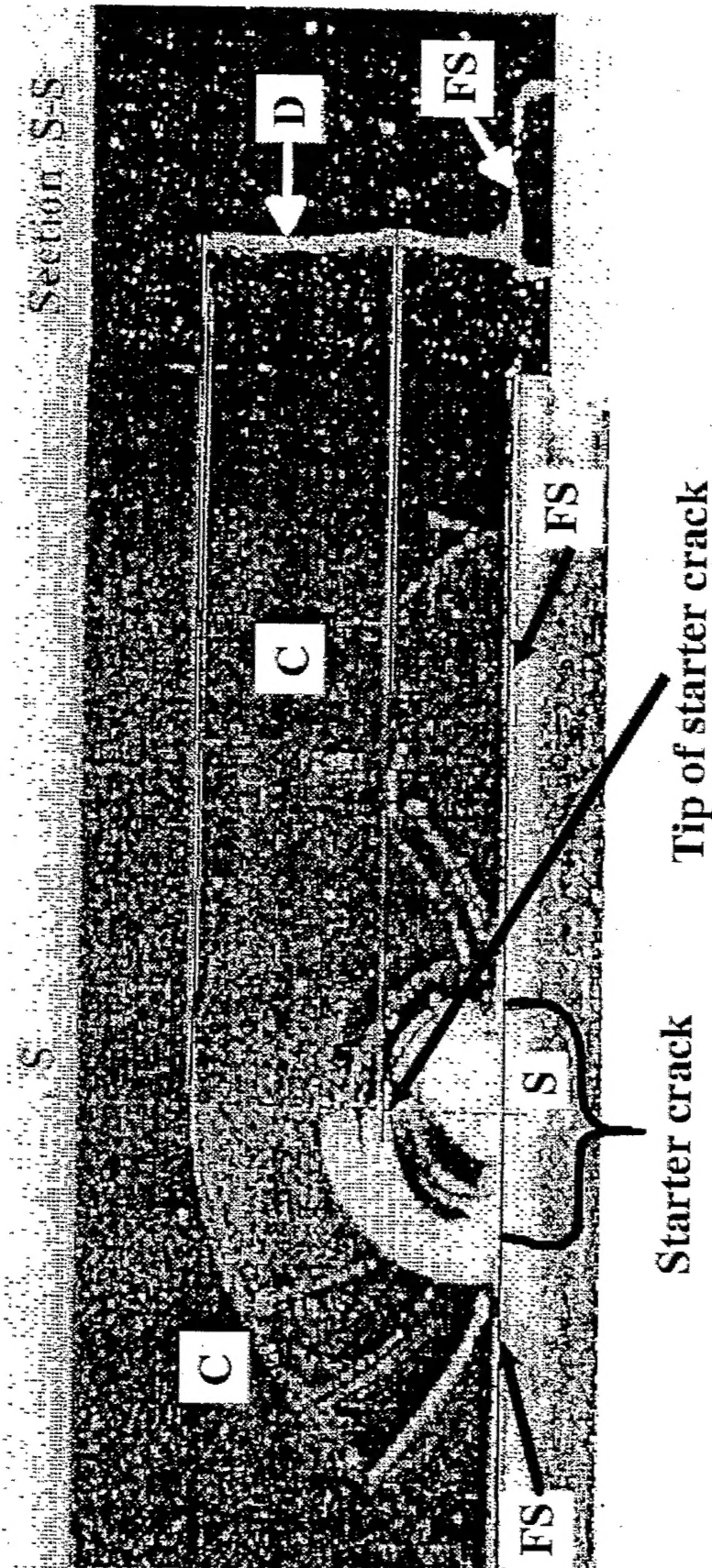
**Crack Turning
Completed**



**Crack Turning
Incomplete**



Typical Off-Axis Straight Crack Which is Parallel to the Fin Axis

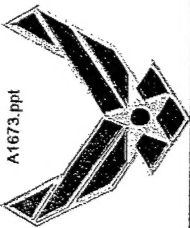


Fin surface

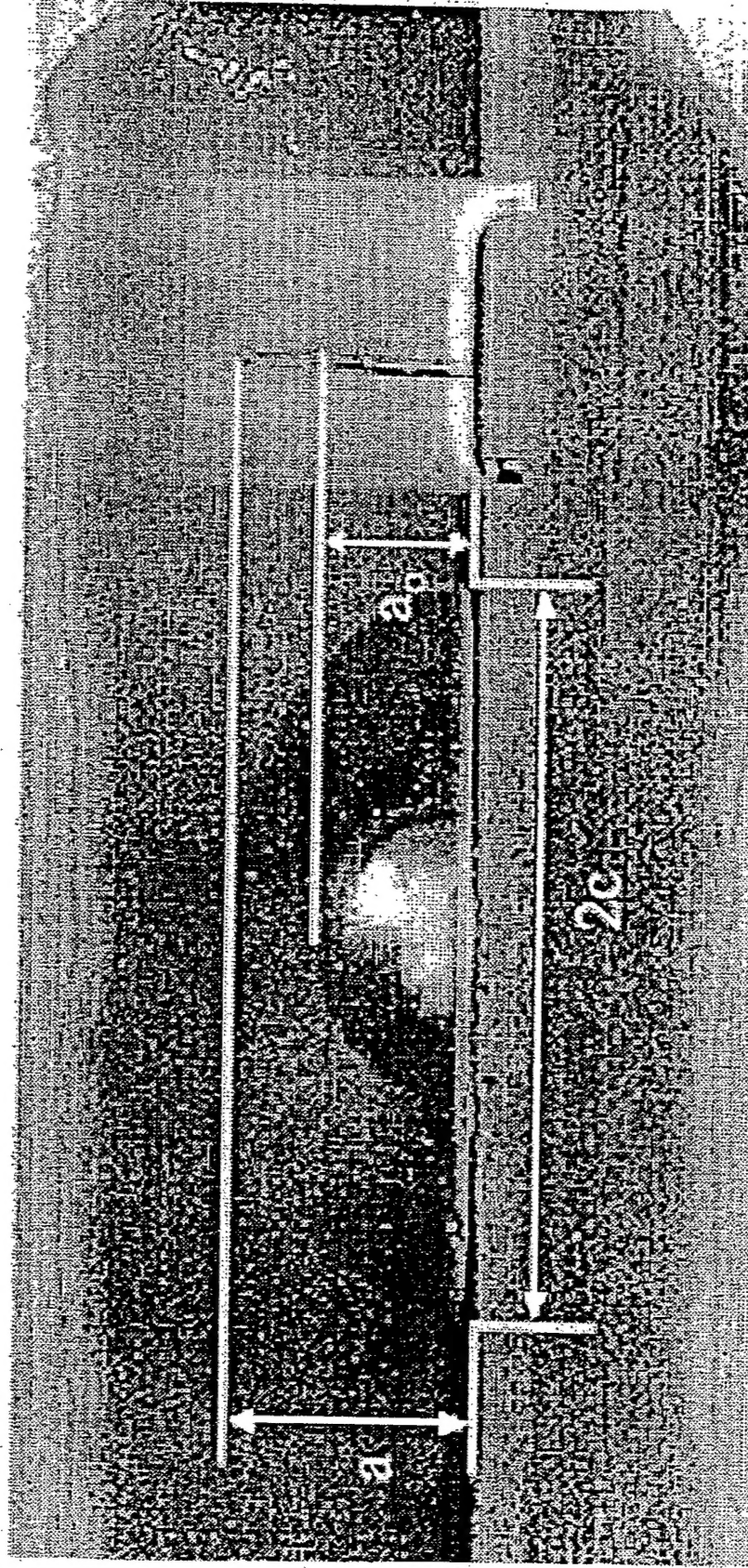
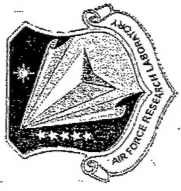
C - crack front

D - camera view of the photograph

Magnification factor: 1.73



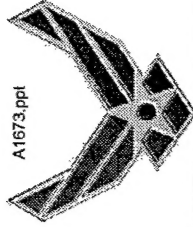
Typical Symmetric Crack Which is Near the Fin Axis



a_0 - initial crack

a - final crack

MF 2.52



Conclusions:



- When the crack is perpendicular to the fin surface, a significant three-dimensional effect occurs during crack turning.
- During crack turning, normal mode (Mode I) and shear modes (Mode II and Mode III) are developed at the crack tip.
- After the crack turning process is completed, the crack grows under normal mode (Mode I loading).
- When the crack is parallel to the fin axis, there is no crack turning observed and the crack grows under normal mode only.
- Crack turning induces a significant reduction in crack growth rate.